SYLLABLE WEIGHT AND SECONDARY STRESS IN ENGLISH SUFFIXAL DERIVATIVES

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Syllable Weight and Secondary Stress in English Suffixal Derivatives

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Abstract

This paper investigates the relationship between syllable weight and secondary stress in a corpus of 1450 English suffixal derivatives. In order to do so, two definitions of syllable weight have been used to code the data and we evaluated whether syllable weight had any impact on stress preservation, as proposed by Pater (1995; 2000). The results indicate that syllable weight has no influence whatsoever on stress preservation, in both definitions of syllable weight under examination.

1. Introduction

Most studies on English phonology since Chomsky & Halle (1968) assume that there exists a correlation between syllable weight and stress, even though this relationship has been noted to be less straightforward for secondary stress than for primary stress. Moreover, this claim is not uncontroversial even though it is the "standard" view, and there is controversy both on the nature of the elements which may or may not contribute to syllable weight and whether syllable weight and stress are actually correlated at all. In this paper, we will start by reviewing the generalisations which have been argued to regulate English secondary stress (§2). Then, we will present the two hypotheses on the relationship between syllable weight and secondary stress which we will confront to our corpus (§3). The latter will be presented in §4 and the results of the study will be presented in §5 and discussed in §6.

2. The Generalisations on Secondary Stress

A review of the literature reveals that most authors agree on the main generalisations regulating English secondary stress. These generalisations are best formulated as surface well-formedness constraints, much in the way Optimality Theory (thereafter OT, Prince & Smolensky 1993) defines them, even though this is not the framework which is adopted here. In this section, we will review these constraints. We will shortly define them, mainly following Fournier (2010b), as the definitions that he gives seem to be the most concise and can be easily translated into any theoretical framework.

2.1./00-/*

Following Fournier (2010), Guierre (1979), Trevian (2003) and other authors working in the framework introduced by Guierre (*ibid.*), we consider English to have only three levels of stress:

- Primary stress, noted /1/ or [ˈ];
- Secondary stress, noted /2/ or [ˌ];
- Absence of stress, noted /0/.

This first constraint can therefore be read in the following way:

(1) */00-/
"No unit may begin with two unstressed syllables" (Fournier 2010b: 12).

Most frameworks agree on this constraint, even though its formalisation may vary. It is defined in similar terms by Guierre (1979: 317), Schane (2007), Trevian (2003: 11) and Wenszky (2004: 66-67) and is often found with the proposed "reparation" which is commonly attested when this constraint could be violated: an initial secondary stress (Fudge 1984: 31; Schane 1979; Solé Sabater 1991).

In frameworks using feet (prosodic units above the syllable whose heads are prominent syllables), most of them in OT, this restriction is achieved on well-formedness conditions on feet (binary, trochaic, weight-sensitive,…) and with constraints such as PARSE-σ (Prince & Smolensky 1993) which require syllables to be parsed into feet or *LAPSE, which forbids sequences of two adjacent unfooted syllables (Bermúdez-Otero & McMahon 2006). As in English feet are claimed to be binary and trochaic, two initial unstressed syllables will have to form a trochaic foot and thus the initial syllable will carry stress.

This constraint has no attested exceptions.

*2.2.*CLASH*

We will use the name *CLASH to refer to Fournier's second principle:

(2) *CLASH
"There cannot be two successive stresses within a single lexical unit" (Fournier 2010b: 12).

In order to be specific about what this constraint does, we need to define what is meant by "lexical unit". Fournier (2010b: 11-12) defines a lexical unit as a semantically inseparable unit and divides lexical units into two categories:

- Autonomous lexical units: words.
- Non-autonomous lexical units: prefixes.[2]

All lexical units must carry a stress, primary stress for words and secondary stress for prefixes. Therefore, stress clashes are frequently attested in "prefix + word" structures whose semantics are compositional, *ˈdo, ˌunˈcover, ˌco-ˈdirect*. This means that the restriction against stress clashes is restricted to a domain, that of the lexical unit.

The tendency to avoid adjacent stresses can be found in most of the literature on English stress, even though it requires us to specify the position adopted here with regards to the relationship between vowel quality and stress. In most generative works on English stress, a parallel relationship between stress and vowel quality is assumed: full vowels are always assumed to be stressed and reduced vowels are seen as unstressed. We follow pronunciation dictionary conventions according to which full vowels may be unstressed. This position is also that of

[2] The prefixes concerned here are those which, being semantically inseparable units, have a meaning of their own and can be found in constructions with compositional semantics, *e.g. re-act* (≠ *react*), *ex-actor* (≠ *exactor*). Since Siegel (1974), they have been commonly referred to as "Class-II" prefixes. However, some prefixes traditionally classified as "Class-I" do constitute lexical units in Fournier's sense, *e.g. iN-* (see also Raffelsiefen (1999), who rejects the class-based analysis in favour of a semantically-based prosodic analysis).

Burzio (1994, 2007) and is discussed at length by Collie (2007: 56 *ff.*).[3] One of the main problems of assuming a parallel relationship between stress and vowel quality is that it makes extrametricality (Hayes, 1982) necessary in words whose ultima contains a full vowel. As pointed out by Burzio (1994: 117, 125), the position of main stress in these words is unaffected by the presence or absence of this putative final "stress" and this vowel would be pronounced identically with or without stress.[4]

As a consequence of this parallelist view, authors such as Pater (1995, 2000) observe that clashes of secondary stresses are commonplace whereas stresses adjacent to primary stress are dispreferred. This is the reason he formulates the following constraint:

> *CLASH-HEAD: No stressed syllable may be adjacent to the head syllable of the Prosodic Word.

In our view, this constraint actually expresses two distinct generalisations:

- What we see as "proper" stress clashes (and not just a sequence "full vowel – stressed syllable") are dispreferred.
- Vowel reduction is common in syllables adjacent to the syllable receiving primary stress.

In the view adopted here, there are far less possibilities of stress clashes as not all full vowels are seen as being stressed, which is why we decided to call that constraint *CLASH, as the specificity of Pater's *CLASH-HEAD, adjacency to primary stress, is not required here.

On the contrary to */00-/, *CLASH has exceptions:

- Trevian (2003: 82-87) mentions the case of final stressed words in *-ee, -ade* ou *-ese* (e.g. *diˌvorˈcee, ˌgoaˈtee, (ˌ)arˈcade, ˌChiˈnese*).
- Derivatives with a /021(-)/ stress pattern, e.g. *aˌcousˈtician*, *deˌpartˈmental*, *eˌlecˈtricity*, which usually have a heavy second syllable (Collie 2007: 79; Kager 1989: 171). This stress pattern is usually used as an argument in favour of cyclic stress preservation as it is thought not to occur in non-derived words.[5]

2.3. Secondary Stress in Derivatives

Suffixed words tend to preserve stresses from their bases when the resulting stress pattern does not violate *CLASH. This generalisation is proposed in similar terms in Fournier (2010b: 79-80), Guierre (1979: 335) and Trevian (2003: 11) and has been the object of much discussion in generative phonology as it was the main evidence for the phonological cycle, a concept which

[3] See also Schane (2007) and Van der Hulst (2002, 2012) who distinguish the traditional view of "stress", in which a symmetrical relationship between stress and vowel quality is assumed, from "accent", which is what pronunciation dictionaries indicate.

[4] Burzio (1994, 2007) also develops an acoustic-perceptual analysis according to which consonants require a certain "vocalic support", and some consonants more than others. Therefore, the presence of full vowels can be accounted for by factors independent of stress. This view seems to be confirmed by a vast corpus-driven study by Dahak (2011) on unstressed syllables which shows that vowel reduction depends on several parameters such as morphology, the consonantal environment following the vowel (*e.g.* velars are seen as the most "reduction-blocking" consonants), full vowel timing or word frequency.

[5] However, this is not entirely true, we found four non-derived words in Wells (2008): *cheongsam, electrolysis, refractometer, reluctivity.* The first one is probably special as it can easily be identified as a borrowing and the last three are morphologically complex but do not have attested bases.

was introduced by Chomsky & Halle (1968).[6] It has been formulated through other theoretical apparatuses such as Metrical Consistency ("Every morpheme must be as metrically consistent as possible", Burzio, 1994: 228) or Output-Output Correspondence (Benua 1997 and subsequent works).

Stress preservation sometimes fails (see Collie 2007, 2008 for examples and discussion) and sometimes violates *CLASH, *e.g.* in the case of /021-/ derivatives which were mentioned in the previous section.

For the rest of the paper, this generalisation will be referred to as ID-STRESS or "stress preservation" and is defined in (3).

(3) ID-STRESS
Stresses from embedded bases should be preserved.

3. THEORY AND SYLLABLE WEIGHT

3.1. Structure and Stress: Two Hypotheses

In various approaches to English phonology, it has been suggested that syllable weight may influence stress placement. We are here interested in two of these approaches, which will be seen as two hypotheses about what elements of syllable structure are relevant for stress placement.

3.2.Hypothesis 1

The first hypothesis is inspired by Fournier (2010b), Guierre (1979), Trevian (2003), whose large corpus-based studies on pronunciation data show that certain consonant clusters, which we will call functional consonant clusters, can influence stress placement and the value of the preceding vowel (vowels are generally short before a consonant cluster). Fournier (2010b: 28) defines what clusters are functional, and that excludes /Cr/ clusters.[7] Interestingly, these functional consonant clusters differ from clusters usually syllabified heterosyllabically only in the case of /Cl/. /Cl/ clusters are usually syllabified as branching onsets because they also occur word-initially.

The inclusion of /Cl/ in functional clusters is based on cases such as *igloo, ugly, kibla* or *tabla,* which all have the shape (-)VClV#.[8] If /Cl/ was not functional, we would expect the first vowel of these words to be long, like all vowels in the environment (-) __CV#, which is not the case. /Cr/ clusters, however, do not behave in the same way as /Cl/ clusters, as shown by the following words with long vowels: *cobra, micra, negro.*

[6] For discussion on cyclic secondary stress, see Hammond (1989), Hayes (1982), Kiparsky (1979), Pater (1995, (2000) and many others.
[7] Fournier's approach is also based on orthography, and orthographic consonant geminates are seen as functional clusters, even though Guierre (1979: 285-286) notes that they differ from "true" consonant clusters in that they do not block vowel reduction in initial pretonic position as systematically as the latter. Other authors have suggested that orthographic consonant geminates might have an effect on phonology (Burzio 1994: 56-57; Chomsky & Halle 1968: 148; Collie 2007: 134; Deschamps 1982; Giegerich 1999: 231; Liberman & Prince 1977; Stockwell & Minkova 2001: 173).
[8] "#" indicates a word boundary.

We propose to reformulate the generalisation expressed by the categorisation of consonant clusters previously discussed in terms of syllabification. As we mentioned above, /Cl/ clusters are the only element for which traditional analyses to syllabification and the "functional cluster" approach differ. Therefore, we suggest that all consonant clusters but /Cr/ are syllabified heterosyllabically. Kiparsky (1979) and Hammond (1999) note that syllabifying /Cl/ clusters as /C.l/ does not violate the sonority scale.

However, the main difference between the two hypotheses explored here concerns vowels. In this first approach, vowels are seen as being contextually determined by their environment, and that environment includes the presence or absence of stress. In other words, stress may influence vowels but not the other way round. This view is supported by the fact that vowels are extremely variable (they can alternate in cognate words or reduce), as opposed to the extreme stability of consonants. Moreover, the generalisations concerning which vowels are allowed in a given context are well studied (Deschamps 1994, Deschamps *et al.* 2004, Fournier 2010b). This view on vowels is developed in Dabouis (2014) and its relation with syllable weight in Dabouis (forthcoming).

3.3.Hypothesis 2

The second approach is aimed to be close to the more "traditional" view on syllable weight, although we had to make a series of choices as it appeared that we did not find any "ready-to-go" guide to determine if a syllable is heavy in derived words in the literature. The main issue is whether we choose to determine syllable weight based on the surface properties of syllables, which can lead us to have two different weights for a given syllable if its vowel alternates or reduces in the base or the derivative, or to try to determine an "underlying" weight. As it seemed to us that the first approach is very restrictive and presents risks of circular reasoning, we adopted the second approach, which does not have these two shortcomings.

Therefore, we classified as H(eavy) all syllables which:

- Contain a long vowel:
    - In both the base and the derivative, *e.g. in*[ɔː]*gurate* → *in*[ɔː]*guration* #LHL;[9]
    - In the base, but which reduces in the derivative (or conversely), *e.g. comm[juː]te* → *comm[jə]tation* #LH*; d[ə~i]port* → *d[iː]portation* #HH.
- Are closed by a consonant, following the Maximal Onset Principle (with the exception of sC(C) clusters, see the following section), *e.g. inferiority* #HHL

However, we excluded from the data cases of vowel alternations between long and short vowels either between the base and the derivative or only for the derivative (*e.g.* [iː ~ e]*lasticity*).[10]

All other syllables are treated as (L)ight.

Because of the exclusions made for this approach, we will have different counts for the two hypotheses in the results.

[9] As we will be interested only in the pre-tonic sequence, we will transcribe in (L)ight and (H)eavy only that sequence.

[10] Alternations between [aɪ] and [ɪ] were also excluded, even though [ɪ] can also be a reduced vowel.

3.4.The Case of Sonorants and /s/

The predicting power of the Weight-to-Stress Principle (which will henceforth be referred to as WSP) has been considerably reduced by the observation that syllables closed by sonorants or /s/ do not, it is claimed, behave like other clusters. Indeed, we can find pairs such as *seˈmester* - *ˈminister* which both have a heavy penult and that should, according to the generally accepted rule of primary stress placement, receive primary stress. However, in *ˈminister* and a number of other cases it does not, which led to a variety of proposals according to which these syllables are subject to specific destressing rules or, even, would be quasi-light when unstressed and heavy when stressed (Burzio 1994: 61-62; Giegerich 1999: 371; Halle & Vergnaud 1987: 257; Selkirk 1984: 127; Wenszky 2004). The latter proposal is particularly problematic because it is circular.

Intuitively, there seems to be another issue with this proposal: we felt that the proportion of codas containing these consonants would be a rather big one. Therefore, in order to get an idea of what that proportion might be, we looked through a slightly larger corpus than the one which was used for the study discussed in the following sections[11] so as to get an idea of the proportion of codas concerned by this proposal. The corpus used contains 1865 suffixal derivatives, in which we found 998 internal codas. Among these codas, 688 (69%) are sonorants or /s/.

This is a strikingly high proportion. Over two thirds of internal codas in this inventory would be concerned by this proposal. If the proportions in the penult were found to be similar, it would mean that, in over two thirds of words with a closed penult, the commonly accepted rule of stress assignment to a heavy penult would be reduced to chance.

We could add, using examples from Fournier (2010a), that words with penults closed by consonants other than sonorants and /s/ may also be exceptional with regards to this rule, such as the examples taken from the list he gives of words other than those with a closed penult followed by an adjectival suffix: *adjective*, *character*, *galaxy*, *palimpsest* are all stressed on their antepenult. Comparatively, within the same inventory, *invective*, *perspective*, *subjunctive*, *preceptor*, *conjecture*, *conjuncture*, *Benedictine*, *elixir* are stressed on their penult. Therefore, within words with a penult closed by a consonant other than a sonorant or /s/, 8/12 (67%) are stressed on the penult. Thus, even with consonants held to contribute to syllable weight in all circumstances, the generalisation on primary stress seems to be a fairly weak one.

Consequently, we will hold all consonants in the coda to contribute to syllable weight in all environments and reject the circularity of the above proposal.

3.5. The Hierarchy of Generalisations

Fournier (2010b: 79-80) argues that secondary stress in English suffixed words is governed by the "Law of Secondary Derivation" according to which stresses in the base are preserved in the corresponding derivative unless this preservation violates the second principle, *CLASH. In the case of a violation, secondary stress is normally found on the first syllable, *e.g.* *obˈjective* → *ˌobjecˈtivity* (**obˌjecˈtivity*). Using the names of the generalisations introduced above, this

[11] The corpus used here is an unsorted version of that used in the following sections. It is still made up of suffixal derivatives in *-(at)ion*, *-ian*, *-ity* or *-al* but contains all excluded items discussed in section 4, apart from compounds which are not included here either.

means that *CLASH dominates ID-STRESS. However, (Pater 1995; 2000) proposes the hierarchy of constraints in (4) in his OT analysis of English secondary stress.

(4) *CLASH-HEAD>>WEIGHT-TO-STRESS >> ID-STRESS

In this proposed hierarchy, *CLASH and ID-STRESS are indeed ordered as they are by Fournier, but Pater introduces WEIGHT-TO-STRESS[12], which predicts that, if stress preservation was to preserve stress on a light syllable when a heavy syllable is available, then stress should fall on that syllable, in violation of ID-Stress. Using OT formalism, this can be represented in the tableau in (5).

(5)

ĹHL	*CLASH-HEAD	WEIGHT-TO-STRESS	ID-STRESS
[LH]L		*!	
💣L[HL]			*

Therefore, verifying whether the predictions made by Pater's hierarchy are correct will be one of the aims of this paper.

3.6. Aims of the Present Study

The main goal of this study is to evaluate the role of syllable weight with regards to stress preservation in English suffixal derivatives, and to examine, at the same time, whether one of the two hypotheses regarding what elements make a syllable "heavy" stands out. In order to do so, the data will be examined through the prism of both hypotheses at every step of the study.

To evaluate the role of syllable weight, we will try to answer the following research questions:

1) Can syllable weight account for stress clashes? (*e.g. deˌpartˈmental*)
2) Do the stress patterns generally respect WEIGHT-TO-STRESS?

4. CORPUS

Following the approach introduced by Guierre (1979), we chose to seek the answers in the examination of a corpus of pronunciation dictionary data. This is not the only way to conduct investigations on lexical stress (*e.g.* see Turcsan & Herment (2016) for an investigation of the stress patterns of English disyllabic nouns and verbs through a nonce word reading task) but we believe that dictionary data is best suited for analyses such as the one conducted in this paper, as the number of parameters that come into play might be difficult to control in an experimental task. More crucially, we believe that the answers should not be sought through the examination of selected or "convenient samples" (Wenszky 2004: 12), whose role should be that of being exemplary of the classes they represent and should not constitute the main source of data for analysis. This methodology follows from our agreement with statements such as that of Domahs *et al.*'s (2014) when they underline the fact that several studies on English

[12] Following Prince & Smolensky (1993), Pater describes WEIGHT-TO-STRESS as a constraint "which requires that heavy syllables be placed in head position of a foot".

phonology "suffer from a scarcity of systematic empirical evidence".[13] Consequently, we will examine a corpus as large and representative as possible in order to answer our research questions.

The corpus used for this study is taken from a larger corpus on the study of secondary stress in contemporary British English. This larger corpus contains over 10,000 words which were extracted from Wells (2008) through the LLL's Dictionary Database.[14] As the phenomenon examined in that larger work is secondary stress, the dictionary entries which were extracted are only those which contain a secondary stress.[15] Our study being focused on cases of stress preservation, and more precisely what has been called "Weak Preservation" Burzio (1994), *i.e.* stresses are preserved from a base to its derivative (with stress-shifting suffixation) but not to the same degree. Therefore, we chose to study all derivatives in the corpus containing either *-(at)ion, -ian, -ity* or *-al*, which are all usually described as "Class-I suffixes" (after Siegel 1974), *i.e.* stress-affecting suffixes (among other properties).

In order to limit biases from other parameters, we chose to exclude the following words:

1) Compounds (*e.g. cross-sectional, lackadaisical*);
2) Learned compounds (*e.g. ethnological, synchronicity*);
3) Prefixed constructions with a compositional meaning (*e.g. amoral, decontamination, unpredictability*);
4) Prefixed constructions whose prefix may have a transparent meaning (*e.g. deflation, decryption*); [16]
5) Derivatives whose meaning is unrelated to that of their base (*e.g. universe* > *university*);
6) Words derived by substitution (*e.g. proletariat* > *proletarian*);
7) Words whose syllable count is variable (*e.g. fluorination* [ˌflɔː-] ~ [ˌfluː‿ə-])
8) Words with more than four pre-tonic syllables (*e.g. epidemiological, exteriorization*)

After this data cleaning, the corpus contains 1450 entries.

The corpus was then coded with H and L according to the two hypotheses described in §3. Examples of coding are given in Table 1.

[13] For example, in a review of Hammond (1999), McMahon (2002), after underlining the fact that "problem in phonology, especially the sort that rather distances itself from phonetics, of reliance on stock examples and introspection", points out that at no point in Hammond's book are the data sources introduced or discussed, even though the author claims to have used "several computer databases" (Hammond 1999: 332). McMahon seems forced to state the obvious: "courtesy in scientific enquiry involves ensuring that your results can be repeated by other investigators".

[14] This database is a work in progress which compiles information from three reference pronouncing dictionaries: the *Cambridge English Pronunciation Dictionary,* the *Longman Pronouncing Dictionary* and the *Macquarie Dictionary.* The first two describe American English and British English, whereas the third describes Australian English. Although this database is incomplete, it already contains a lot of usable data.

[15] We point out that specificity of the corpus as some of the analyses conducted in the following sections will be limited by it.

[16] Raffelsiefen (1993, 2007) argues that prefixes with transparent meaning or in antonymic pairs can form separate phonological words and carry stress (see also Wennerstrom 1993; Videau 2013). Therefore, words containing prefixes which could be interpreted transparently should be left aside as they might compromise the test on stress preservation.

Word	Hypothesis 1	Hypothesis 2
piratical	#L	#H
fragmentation	#HH	#HH
experimental	#HLL	#HLL
acclimatisation	#HLLL	#HHLH

Table 1. Coding according to the two hypotheses

In the following section, we will present the results and see how the WSP interacts with other constraints (exceptional stress patterns, preservation vs. non-preservation). The results will then be discussed in §6.

5. RESULTS

5.1. One pre-tonic syllable

As mentioned in footnote 15, our corpus presents the limitation of containing only words which are noted in Wells (2008) as having a secondary stress. As all words in English need to have a stress on one of the first two syllables, the only case for which this limitation will be relevant is in the case of words with a single pre-tonic syllable. We cannot compare whether the parameter considered here, syllable weight, has any influence on the presence or absence of secondary stresses, but we can only see whether the one pre-tonic syllable of words which do have a secondary stress on that syllable are indeed heavy.

The distribution of syllable types per hypothesis is shown in Table 2.

	Hypothesis 1		Hypothesis 2	
	Nb	Examples	Nb	Examples
#H	18	*abduction* *baptismal* *stagnation*	27	*piratical* *damnation* *concretion*
#L	11	*dilution* *plurality* *aeration*	1	*ablation*
Total	29		28	

Table 2. Results for words with one pre-tonic syllable

These results show that Hypothesis 2 is the best predictor of the presence of a secondary stress on the initial pre-tonic syllable, as it has only one exception, *ablation*. On the contrary, Hypothesis 1 makes correct predictions only for 18 words out of 29 (62%), which is far from satisfactory. Interestingly, only one word does not inherit this initial stress from its base (even though that stress may be optional in the base): *conˈsensus* → *(ˌ)conˈsensual*. This case seems to follow the generalisation according to which heavy syllables should be stressed.

However, because of the limitations of our corpus, it is impossible to make any definite conclusions on words with one pre-tonic syllable. In our restricted inventory, Hypothesis 2 is a better predictor but it may well be the reverse if the full record is considered.

5.2. Two pre-tonic syllables

Let us first consider the different stress patterns which can be found in the inventory and whose relative proportions are given in Table 3.

		Syllable type	Hypothesis 1		Hypothesis 2	
			Nb	Examples	Nb	Examples
Group 1	/201(-)/	All	782 (98%)	*separation* *prefectorial*	739 (98%)	*adaptation* *congelation*
Group 2	/021(-)/	#LH	2	*semantician* *electoral*	2	*semantician* *electoral*
Group 2	/201(-)/ ~ /021(-)/[17]	#LH	9	*departmental* *eructation*	4	*collectivity* *diffusivity*
		#HH	4	*encrustation* *electricity*	6	*directorial* *perceptivity*
		#LL	1	*diffusivity*		
Total			802		757	

Table 3. Stress patterns of derivatives with two pre-tonic syllables

We divided the data into two groups:

- Group 1: in 98% of all derivatives in both hypotheses, the stress pattern is the one expected by the ranking *CLASH-HEAD >> ID-STRESS, *i.e.* /201(-)/, regardless of the stress pattern of the base. In Hypothesis 1, 605/782 words (77%) already have a base which is stressed on the first syllable; Hypothesis 2 has 582/739 (*e.g.* *ˈregister* → *ˌregisˈtration*)
- Group 2: The remaining 2% in both hypotheses may have a /021(-)/ pattern. In all cases, the secondary stress on the second syllable is inherited from a base stressed on its second syllable (*e.g.* *seˈlective* → *seˌlecˈtivity*). As mentioned in §2.2, cases like these have been reported in the literature, although they are very rare and almost always found in derived words.[18]

As Group 1 is regular, what remains to be evaluated is whether the WSP (in its two formulations) can be held accountable for the exceptional patterns found in Group 2. If it is the WSP which is at the source of these exceptional patterns, then we expect the words which present that stress pattern to have a heavy second syllable.

This is indeed what we find for both hypotheses, with the exception of *diffusivity*, whose pre-tonic sequence is #LL in Hypothesis 1. However, if we look at the problem from the opposite angle, it seems that the reverse does not hold. In Hypothesis 1, there are 150 words with the structure #σH (a heavy second syllable) and only 20 (13%) of these are in Group 2. In Hypothesis 2 out of 230 words (6%) with #σH are in Group 2.

[17] For clarity, the order between main pronunciation and variant is not represented here.
[18] See note 5.

As opposed to derivatives with a single pre-tonic syllable, the WSP as defined in Hypothesis 1 is a better predictor, but it remains a very weak predictor. Possible explanations for the /021(-)/ pattern will be discussed in §0.

5.3. Three and four pre-tonic syllables

As we are now looking at words with more than two pre-tonic syllables, *CLASH should not interfere with stress preservation and we should be able to evaluate how the WSP and ID-STRESS interact. As this interaction is our main concern, we will separate the results between derivatives which preserve the stress pattern of their base and those which do not, variably do and other particular cases.

5.3.1. Stress preserving derivatives

In this configuration, we found four possible patterns of interaction between stress preservation and the WSP:

i. The WSP makes no prediction because there are no heavy syllables (#LLσ words, *e.g. abomination*);
ii. Stress preservation and the WSP make identical predictions and are both satisfied (*e.g.* #LHL *doˈmesticate* → *doˌmestiˈcation*);
iii. The WSP is violated:
    a. When stress preservation maintains stress on a light syllable when there are available heavy syllables (*e.g. ˈcharacterize* → *ˌcharacteriˈzation*; *conˈditional* → *conˌditioˈnality*);
    b. When an initial heavy syllable is unstressed (*e.g. conˌventioˈnality; esˌtablishmenˈtarian*) when we would expect /22-/.

The proportions of each possible pattern are given in Table 4.

		Hypothesis 1	Hypothesis 2
i. No WSP predictions		331 (56%)	110 (19%)
ii. WSP and ID-Stress satisfied		157 (27%)	353 (62%)
iii. WSP violated	a. Stress preservation on L	18 (3%)	19 (3%)
	b. Unstressed initial H	83 (14%)	91 (16%)
Total		589	573

Table 4. Results for stress preserving derivatives of three or four pre-tonic syllables

There seems to be a difference between Hypothesis 1 and 2 in the distribution of words between i and ii, but this is due to the fact that the definition of syllable weight in Hypothesis 2 includes long vowels, which leads to higher numbers in ii. Actually, i and ii represent the “normal” case and the proportions of i + ii between the two hypotheses are very close (83% and 81% respectively).

The most interesting group is that of the words in iii.a, because it contradicts Pater's hierarchy (in (4)). It appears that every time that stress preservation is in conflict with the WSP, it is the former which is satisfied and not the latter.

iii.b has been noted to be too strong a prediction in previous work (Wenszky 2004), therefore it is not surprising to find such high numbers of violations.

Overall, both hypotheses present similar rates of violations of the WSP (17% and 19% respectively). Let us now turn our attention to the remaining derivatives in our corpus.

5.3.2. Non-preserving, variably preserving derivatives

This last inventory can also be divided into four different patterns:

iv. The WSP is violated either because stress preservation on a heavy syllable (variably) fails (*e.g. diˈrectional* → *directionality* /020-/ ~ /200-/) or because a heavy syllable fails to "stabilise" the expected variation when a word has two bases with different stress patterns (*e.g. aˈrithmetic* (n) / *ˌarithˈmetic* (adj) → *arithmetician* /020-/ ~ /200-/);

v. Non-preservation not explained by the WSP because the first two syllables are light (*e.g. aˈcademy* / *ˌacaˈdemic* → *academician* /020-/ ~ /200-/);[19]

vi. (Variable) non-preservation of a stress on the second syllable when the first syllable is heavy. In that case, two interpretations are possible: (1) either the initial heavy syllable indeed "attracts" stress in the derivative, therefore causing non-preservation or (2) some other parameter (*e.g.* relative token frequencies, see §0) causes non-preservation and the application of a "default" rule for the placement of secondary stress: initial stress (Fournier 2010b: 80).[20]

vii. An optional secondary stress is present on the initial heavy syllable (/(2)2-/) of a derivative but is not inherited from its base (*e.g. conˈfigure* → *(ˌ)conˌfiguˈration*). This is predicted by the WSP.

The proportions of each possible pattern are given in Table 5.

	Hypothesis 1	Hypothesis 2
iv. WSP violated	5 (15%)	11 (34%)
v. No WSP explanation	18 (54%)	9 (28%)
vi. WSP or "default"	5 (16%)	8 (25%)
vii. Initial stressed H	5 (15%)	4 (13%)
Total	32	32

Table 5. Results for stress preserving derivatives of three or four pre-tonic syllables

[19] Possible alternative explanations to these exceptions will be discussed in §0.

[20] Fournier's view is at odds with the "default" rule usually proposed in the literature, the Abracadabra Rule (Selkirk 1984: 113) which predicts initial stress only for initial sequences of three light syllables. Additionally, Fournier does not provide any non-derived words with at least three pre-tonic syllables to support his proposal, and this is not surprising as there are few words such as these. We suggest that, if there is a "default" pattern, it is very unlikely to have its origins in these few words, but rather in the predominance of initial stress in the English lexicon (see Clopper (2002) and Cutler & Carter (1987)).

Among the four possible patterns, only one corresponds to satisfied predictions of the WSP, vii. However, few words present this pattern, and the figures are to be put in perspective by considering the high number of violations found in the previous section, *i.e.* words with the iii.b pattern.

Patterns iv and vi correspond to violations of the WSP and represent 31% of the present inventory in Hypothesis 1 and 59% in Hypothesis 2. In that case, Hypothesis 2 seems the best predictor of violations as it leaves less exceptions unaccounted for (pattern v).

Pattern v concerns only words with #LL- and is therefore irrelevant for the evaluation of the interaction between ID-STRESS and the WSP.

6. DISCUSSION

In this section, we will first evaluate the interaction between the WSP and ID-Stress in the light of the results presented here and will propose answers to our two research questions (§3.6). Then, we will see if one of the two hypotheses stands out as a better predictor of secondary stress placement. Finally, we will discuss possible alternative explanations for the exceptions which were encountered.

Which answers to the three research questions?

1) Can syllable weight account for stress clashes? (*e.g. deˌpartˈmental*)

In §5.1, we found a link between syllable weight and the (often optional) presence of a secondary stress on an initial pre-tonic syllable. This is found to be true especially for Hypothesis 2, in which 27 out of 28 words which have a(n optional) secondary stress on their first syllable have a heavy first syllable. However, because of the limitations of our corpus, *i.e.* the fact that it only contains words which do have a secondary stress, it is impossible to evaluate whether the weight of an initial pre-tonic syllable is a good predictor of the presence of a secondary stress on that syllable.

In §5.2, we found that there is a link between syllable weight and the exceptional /021(-)/ stress pattern for both hypotheses. Indeed, all the words which have this exceptional stress pattern all have a heavy second syllable, with the exception of *diffusivity* for Hypothesis 1.

However, out of all the words in #σH, we found that only 13% in Hypothesis 1 and 6% for Hypothesis 2 were in Group 2. Therefore, syllable weight might be a necessary condition for this pattern, but it is not a sufficient parameter. An alternative explanation is discussed below in §0.

2) Do the stress patterns generally respect WEIGHT-TO-STRESS?

We can group in a table the figures of all the words of three or four pre-tonic syllables for which the WSP makes predictions and see whether these predictions are borne out or not. In Table 6, we grouped all WSP violations (iii + iv) and all cases where the WSP makes correct predictions (ii + vii). We excluded all cases where the WSP may conspire with the "default" rule of initial stress or where it does not make any prediction.

	Hypothesis 1	Hypothesis 2
WSP violations	107 (41%)	121 (25%)
WSP satisfied	157 (59%)	357 (75%)
Total	264	478

Table 6. Summary of results concerning the WSP

It would seem that the WSP is a correct predictor in Hypothesis 2, even though 75% of satisfaction is merely half-way between chance and full efficiency. However, there are two problems with this way of presenting the results: (1) we have already mentioned that the prediction that heavy initial syllables should be stressed has been noted to be too strong a prediction, and we indeed find more cases for which it is violated than cases for which it is satisfied; (2) the definition of the WSP in Hypothesis 2 includes long vowels and therefore more syllables are classified as H than in Hypothesis 1. However, we saw that the difference between the two hypotheses with regards to the figures of words in i and ii had to do with the difference in the definition of syllable weight. In both cases, stress preservation can account for the observed stress patterns as well.

Consequently, the truly significant cases are those in iii.a, *i.e.* cases for which the WSP and stress preservation make different predictions. In all of these cases, we found that it is stress preservation and not the WSP which applies, as opposed to the prediction made by Pater's hierarchy. We do not find any cases such as (5).

Moreover, the only exceptions which could accounted for by the WSP are those cases for which a(n optional) secondary stress is introduced in a derivative with a heavy initial syllable. Exceptional stress patterns cannot be accounted for by the WSP and will have to be accounted for through other parameters.

Therefore, it appears that Pater's hierarchy of constraints does not make correct predictions: we never find words which satisfy the WSP and violate ID-STRESS.

Which is the best WSP hypothesis?

At all stages in our investigation, we found similar numbers for both hypotheses, apart from the differences between i and ii, which was argued to be irrelevant. Therefore, our conclusion is that, as far as secondary stress in suffixal derivatives is concerned, the WSP is virtually irrelevant for both definitions.

Alternative explanations

We found that the hierarchy proposed by Pater does not make correct predictions, therefore we propose the new hierarchy in (6).

(6) *CLASH >> ID-STRESS >> WEIGHT-TO-STRESS

As the role of the WSP was shown to be marginal, it could be argued that only the first two constraints are really important, which conforms to Fournier's (2010b) proposal.

Still, this hierarchy might account for 96% of all cases, we still need to propose what could possibly explain the exceptions, *i.e.* /021(-)/ words or cases of non-preservation. We believe that such an account can be provided by relative token frequencies, following Collie (2007; 2008) and Kraska-Szlenk (2007). This hypothesis follows from dual-route race models of lexical access such as that proposed by Hay (2001) according to which there are two routes to retrieve a complex word from the lexicon: a direct route or a decomposed route. A route is preferred if it is used more frequently than the other. Therefore, if the base of a complex word is more frequent than that complex word, then the decomposed route will be preferred. Conversely, if the complex word is more frequent than its base, then the direct route will be preferred. When applied to stress preservation, the prediction is that we expect stress preservation to be more likely to succeed if the base is more frequent than its derivative and more likely to fail if the derivative is more frequent than its base. Collie (2007; 2008) has shown that this appears to be confirmed with derivatives with three pre-tonic syllables.

In a follow-up study (Dabouis in preparation), we evaluated whether this proposal could account for the /021(-)/ pattern and found that relative token frequencies is indeed a significant predictor of the /021(-)/ pattern. Some additional parameters such as the place of articulation of the coda of the second syllable also seem to influence stress preservation in that environment: words with a non-coronal coda more often show that stress pattern.

7. CONCLUSION

In our investigation of the link between syllable weight (in the two considered definitions) and stress preservation, we found that the former is virtually irrelevant for the placement of secondary stress in English suffixal derivatives and that Pater's (1995; 2000) hierarchy of constraints should be revised so that ID-STRESS dominates WEIGHT-TO-STRESS.

It was found that simply keeping the hierarchy *CLASH >> ID-STRESS could account for 96% of the data, which confirms Fournier's (2010b) proposal.

Finally, we suggested that relative token frequency could be a significant predictor of stress preservation failure (Collie 2007; 2008) and of exceptional stress preservation, *i.e.* when the latter leads to a stress clash (Dabouis in preparation). We believe that the extent to which relative token frequencies influences stress preservation overall is still to be evaluated and offers exciting prospects for future research.

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